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ABSTRACT

The course outlined is one of the required courses in the Radio and Television Service Curriculum. Mastery of the skills in Basic Radio Circuits and Vacuum Tube AM Troubleshooting (9785.03) is a prerequisite. Eight blocks of instruction are divided into several units each. The instruction blocks are: orientation, fundamentals of transistor receivers, no signal in transistor receivers, additional symptoms, automobile radios, FM receivers, stereo multiplex systems, and a post-test. Specific block objectives are outlined. In the 135 hours of course presentation, classroom lessons, textbook assignments, construction of transistor radio kits, laboratory exercises, and troubleshooting practice are employed. An answer key is provided for the two-part post-test, and a bibliography lists basic and supplementary references and films. (AG)

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AUTHORIZED COURSE OF INSTRUCTION FOR THE QUINMESTER PROGRAM

DEPARTMENT OF HEALTH
EDUCATION & WELFARE
NATIONAL INSTITUTE OF
EDUCATION

Course Outline
RADIO AND TELEVISION SERVICE - INTERMEDIATE - 9785
(Transistor Radio Receivers)
Department 48 - Quin 9785.04

CE 002 237

DADE COUNTY PUBLIC SCHOOLS
DIVISION OF INSTRUCTION • 1973

ED 097471

D A D E C O U N T Y P U B L I C S C H O O L S

1 4 5 0 N O R T H E A S T S E C O N D A V E N U E

M I A M I, F L O R I D A 33132

Course Outline

RADIO AND TELEVISION SERVICE - INTERMEDIATE - 9785
(Transistor Radio Receivers)

Department 48 - Quin 9785.04

county office of

VOCATIONAL AND ADULT EDUCATION

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Dr. E. L. Whigham, Superintendent of Schools
Dade County Public Schools
Miami, Florida 33132

February, 1973

Published by the School Board of Dade County

Course Description

9785	48	9785.04	Transistor Radio Receivers
State Category Number	County Dept. Number	County Course Number	Course Title

This is a basic quinmester course which includes a study of transistor circuits of AM and FM auto and home radios and FM stereo multiplex systems. Laboratory experiments and live production work supplement the related text material. This is a two or three quinmester credit course of one hundred thirty five hours duration.

Indicators or Success: Prior to entry into this course, the vocational student will display mastery of the skills indicated in Basic Radio Circuits and Vacuum Tube AM Troubleshooting (9785.03).

Clock Hours: 135

PREFACE

The following quinmester course is one of the required quins in the Radio and Television Service Curriculum. Mastery of the skills in Basic Radio Circuits and Vacuum Tube AM Troubleshooting (9785.03) is required for entry into this study of transistor radio receivers.

This outline consists of eight blocks of instruction which are subdivided into several units each. The course is 135 hours in length.

Instruction is accomplished by means of classroom lessons, textbook assignments, construction of transistor radio kits, laboratory exercises and troubleshooting practice.

Students learn to perform the required skills efficiently and accurately, taking into account the individual student's abilities and aptitudes. The successful student of this course develops a closer attention to detail and accuracy in diagnosing defective circuits and making repairs.

This outline was developed through the cooperative efforts of the instructional and supervisory personnel, the Quinmester Advisory Committee, and the Vocational Curriculum Materials Service, and has been approved by the Dade County Vocational Curriculum Committee.

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with Suggested Hourly Breakdown

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Analyzing the How and Why of Transistor Amplification	1
Turning the Transistor On	2
Derivation of the AGC Circuits	2
Surveying Solid State Power Supplies	2
Audio Output Stages	2
Mixers and Oscillators	2
III. NO SIGNAL IN TRANSISTOR RECEIVERS (15 Hours)	
Making Current Measurements	2
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GOALS

The student must be able to demonstrate:

1. Knowledge of school and classroom rules of procedure, safe handling of tools and equipment, organization and management of the classroom.

2. Understanding of the requisites for filling an entry level job and employment opportunities in his field.

3. Knowledge of solid state theory and its application to practical application of transistors to radio uses.

4. Knowledge of current measurement in transistor radios, uses of signal injection and signal tracing and the causes of trouble symptoms.

5. Knowledge of the special field of automobile radios and the special circuits involved in signal seeking.

6. Knowledge of AM-FM combination radios and methods of switching from one to the other.

7. Knowledge of the transmission and reception of stereo multiplex signals and the special problems involved therein.

8. Use of instruments and techniques for their use in isolating and repairing troubles.

9. The ability to satisfactorily complete the quinmester post-test.

SPECIFIC BLOCK OBJECTIVES

BLOCK I - ORIENTATION

The student must be able to:

1. State what will be expected of him in meeting the standards of the course, taking tests and performance of manipulative operations.
2. Explain policies regarding attendance, safety regulations, shop management.
3. Discuss job opportunities and the qualifications for meeting these opportunities in entry level employment.
4. Demonstrate familiarity with the use of the text by locating topics in the index and by using the glossary.

BLOCK II - FUNDAMENTALS OF TRANSISTOR RECEIVERS

The student must be able to:

1. Read and draw schematic diagrams of transistor radio circuits.
2. Calculate bias voltages and gain ratios.
3. Construct power supplies and amplifier circuits, mixers and RF oscillators.

BLOCK III - NO SIGNAL IN TRANSISTOR RECEIVERS

The student must be able to:

1. Locate inoperative stages by methods of static and dynamic testing, signal injection and signal tracing.
2. Differentiate between oscillator failure and failure of other circuits.

BLOCK IV - ADDITIONAL SYMPTOMS

The student must be able to:

1. Use appropriate instruments and methods to demonstrate occurrence of distortion, high input current, motorboating and low gain.
2. Diagnose and eliminate causes of distortion, high input current, motorboating and low gain.

BLOCK V - AUTOMOBILE RADIOS

The student must be able to:

1. Apply previously learned principles and techniques to the troubleshooting and repair of automobile radios.
2. Diagnose troubles in and repair of signal-seeking circuits and associated mechanical devices.

BLOCK VI - FM RECEIVERS

The student must be able to:

1. Diagnose and repair defective FM circuits.
2. Perform complete alignment of FM receivers.

BLOCK VII - STEREO MULTIPLEX SYSTEMS

The student must be able to:

1. Define stereophonic sound and demonstrate a knowledge of multiplex circuits by means of schematic diagrams.
2. Troubleshoot and repair stereo multiplex systems.

BLOCK VIII - QUINMESTER POST-TEST

The student must be able to:

1. Pass the quinmester post-test.

Course Outline

RADIO AND TELEVISION SERVICE - INTERMEDIATE - 9785
(Transistor Radio Receivers)

Department 48 - Quin 9785.04

I. ORIENTATION

A. Objectives of the Course
   1. Standards for performance of assigned work
   2. Methods of evaluation:
      a. Paper and pencil tests
      b. Oral responses
      c. Manipulative skill performance
      d. Troubleshooting and repair work
   3. Teaching methods
      a. Lectures
      b. Demonstrations
      c. Information and job sheets

B. Student Responsibilities:
   1. School policies relative to absences
   2. Safety regulations
   3. Work regulations
      a. Appropriate dress
      b. Care of hand tools
      c. Use and care of equipment
      d. Materials and supplies
      e. Means of reporting lost equipment
      f. Means of reporting inoperative equipment
      g. Production shop policies
      h. Housekeeping

C. Student Benefits
   1. Opportunities for employment
      a. Scope of the trade
      b. Job availability
      c. Remuneration
   2. Personal improvement through hobby activities

D. Introduction to the Text
   1. Overview of chapter headings
   2. Bibliography
   3. Glossary
   4. Use of text and assignment sheets

II. FUNDAMENTALS OF TRANSISTOR RECEIVERS

A. Analyzing the How and Why of Transistor Amplification

B. Turning the Transistor On:
   1. Forward bias
   2. Reverse bias

C. Derivation of the AGC Circuit
   1. Application to RF circuits
   2. Application to IF circuits

D. Surveying Solid State Power Supplies
   1. Battery power sources
   2. Rectifier power supplies
      a. Application of Zener Diodes
      b. Regulation of voltage

E. Audio Output Stages
   1. Transformer types
   2. Transformerless types
      a. Conventional audio output stages
      b. Complimentary symetry amplifiers
   3. Stabilization of amplifiers
      a. How the emitter resistor stabilizes
      b. Diode stabilization circuits

F. Mixers and Oscillators
   1. Feeding back
      a. From collector to emitter
      b. From collector to base
   2. Heterodyning oscillator and RF signals

III. NO SIGNAL IN TRANSISTOR RECEIVERS

A. Making Current Measurements
   1. Idling current
   2. Measuring current at full load

B. Injecting Test Signals
   1. Radio frequency injection
   2. Audio frequency injection

C. Failure of the Oscillator
   1. Measuring oscillator voltages
   2. Checking oscillator coils
   3. Checking transistor condition

IV. ADDITIONAL SYMPTOMS

A. Analyzing Distortion
   1. Scoping waveforms
   2. Listening tests for distortion

IV. ADDITIONAL SYMPTOMS (Contd.)

B. Analyzing Abnormal Input Current
   1. Idle current
   2. Full load current

C. Analyzing Oscillations
   1. Motorboating
   2. Heterodyning

D. Analyzing Low Gain
   1. Failure of transistors
   2. Open or shorted capacitors
   3. Changing resistance values

V. AUTOMOBILE RADIOS

A. Comparing the Auto Radio RF Circuit

B. Auto Radio RF Troubles

C. Description of Signal Seekers
   1. The trigger circuit
   2. Analyzing the operating cycle

D. Troubleshooting the Auto Radio
   1. In-car troubles
      a. Ignition noise
      b. Electrical noise
      c. Antenna induced noise
   2. Service-bench troubleshooting
      a. Selecting the power supply
      b. Using service charts
      c. Using manufacturers data

VI. FM RECEIVERS

A. Comparing FM Transistor Circuitry with Vacuum Tube Circuitry
   1. Tuner
   2. AFC
   3. Demodulation
   4. Aligning tuned circuits

B. Analyzing the AM-FM Combination Receiver
   1. Switching circuits
   2. Mixer circuits
   3. Troubleshooting the combination receiver

VII. STEREO MULTIPLEX SYSTEMS

A. Creation of the Transmitter Signal

B. Receiver Circuits
   1. Frequency division detectors
   2. Aligning multiplex receivers
   3. Troubleshooting multiplex circuits
      a. Warbling or gargling
      b. Squeals
      c. Hissing and background noises

VIII. QUINMESTER POST-TEST

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(Transistor Radio Receivers)

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2. RCA Transistor Manual. Harrison, New Jersey: Radio Corporation of America, Electronic Components and Devices, 1966. Pp. 480.

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A P P E N D I X

Quinmester Post-Test Samples

Quinmester Post-Test

Name _____ Date _____ Score ____

Part-One

Multiple-Choice Test Items

Each statement needs a word, a figure, or a phrase to make it correct. Only one of the choices listed is correct. Place the letter of the choice you make in the space provided to the left of the statement.

____ 1. Solid state diodes are said to have a negative temperature co-efficient. This means:

a. The forward resistance decreases as the temperature decreases.
b. The forward resistance decreases as the temperature increases.
c. The forward resistance increases as the temperature increases.
d. The reverse resistance decreases as the temperature decreases.

____ 2. Peak inverse voltage for a diode is:

a. The maximum voltage which can be applied.
b. The maximum reverse bias which can be applied.
c. The forward bias at which avalanche breakdown occurs.
d. The voltage at which termal runaway occurs.

____ 3. When reverse bias is applied to a diode, the barrier region:

a. Becomes wider
b. Becomes narrower
c. Ceases to exist
d. a and c above

____ 4. When forward bias is applied to a diode, the barrier region:

a. Becomes wider
b. Becomes narrower
c. Becomes positively charged
d. b and c above

____ 5. The transistor is the solid-state equivalent of a triode. The triode elements and the equivalent transistor elements are:

a. Cathode-base; plate-collector; grid-emitter
b. Grid-base; plate-collector; cathode-emitter
c. Plate-emitter; grid-base; cathode-collector
d. Plate-base; grid-collector; cathode-collector

___ 6. Minority carriers are:

a. Holes in N-type material
b. Holes in P-type material
c. Electrons which have broken their co-valent bond
d. Electrons in N-type material

___ 7. In "N" type material, the majority carriers are:

a. Holes
b. Electrons
c. Negative ions
d. Positive ions

___ 8. Alpha is a measure of:

a. Resistance gain
b. Current gain
c. Voltage gain
d. Power gain

___ 9. The polarity of the collector voltage for a PNP is:

a. Positive
b. Negative
c. Neutral
d. Same as emitter

___ 10. The PNP transistor, a negative signal applied to the base of a common emitter circuit will:

a. Increase base current
b. Decrease base current
c. Decrease collector current
d. Decrease emitter current

___ 11. Beta is equal to:

a. The change in collector current divided by the change in emitter current.
b. The change in base current divided by the change in collector current.
c. The change in emitter current divided by the change in collector current.
d. The change in collector current divided by the change in base current.

___ 12. Forward bias is always applied between:

a. Collector and base
b. Base and collector
c. Emitter and base
d. Collector and emitter

___ 13. If the collector circuit is opened, it will cause:

a. An increase in base current
b. An increase in emitter current
c. A decrease in base current
d. A decrease in emitter current

___ 14. An open emitter circuit causes:

a. An increase in collector current
b. A drop to zero in collector current
c. A slight decrease in base current
d. None of the above

___ 15. In a common collector circuit the:

a. Output impedance is high and the input impedance is low
b. Output impedance is high and the input impedance is high
c. Output impedance is low and the input impedance is low
d. Output impedance is low and the input impedance is high

___ 16. In a common emitter circuit:

a. The output impedance is high and the input impedance is low
b. The output impedance is high and the input impedance is high
c. The output impedance is low and the input impedance is low
d. The output impedance is low and the input impedance is high

___ 17. The current gain of a common-emitter circuit is designated by:

a. Delta I_c/Delta I_b
b. Delta I_b/Delta I_c
c. Delta I_c/Delta I_e
d. Delta I_e/Delta I_c

___ 18. The gain of a transistor circuit is a ratio of:

a. The output voltage to the load resistance
b. The output to the input
c. The base current to the voltage drop across the transistor
d. The change in base current to the change in collector current

___ 19. Bias stabilization is usually effected by:

a. Regenerative feedback
b. Degenerative feedback
c. Separate power supplies
d. Employing constant voltage supplies

___ 20. In a common emitter circuit, if the emitter bypass capacitor should open up:

a. Signal voltage would be developed across the emitter resistor

b. The gain of the stage would decrease
c. The stage would be degenerative
d. All of the above

___ 21. In a transformer-coupled transistor amplifier, the output impedance of the first stage is 49K ohms and the input impedance to the second stage is 4K ohms. The transformer turns ratio is:

a. 12.25/1
b. 3.5/1
c. 49/1
d. 49/4

___ 22. In a two-stage RC-coupled amplifier, the gain of the first stage is 25 and the second stage is 40. The theoretical gain of the amplifier is:

a. 1000
b. 65
c. 15
d. 1.6

___ 23. Class A transistor amplifiers are operated:

a. Beyond cutoff
b. At cutoff
c. On the linear portion of the characteristic curve
d. With the emitter grounded

___ 24. What polarity should the AGC voltage be in a transistor radio using NPN transistors?

a. Not applicable
b. Zero
c. Negative
d. Positive

___ 25. The overload diode, otherwise known as an auxiliary diode, is for overload protection in the event of:

a. High current from power supply
b. Large signal input
c. Positive feedback
d. None of the above

___ 26. The transistor power supply must have:

a. High voltages
b. Low internal resistance
c. Filter capacitors
d. b and c above

___ 27. The AGC voltage of transistor radios is applied as:

a. Forward bias
b. A.C. voltage
c. Reverse bias
d. A regulated voltage

___ 28. AGC voltage is applied to:

a. RF circuits
b. IF circuits
c. Control gain
d. All of the above

___ 29. A diode rectifier:

a. Has an output only when two signals are present
b. Eliminates undesired portions of the signal
c. Changes A. C. to pulsating D. C.
d. Can be used to maintain a special voltage level.

___ 30. The anode of a diode:

a. Collects electrons
b. Emits electrons
c. Collects or emits depending on the type of material
d. None of the above

___ 31. The components of a pi-section filter are:

a. Input capacitor, output capacitor, and a load
b. Input capacitor, choke, and output capacitor
c. Output capacitor, choke, and load
d. Input capacitor, choke, and load

___ 32. In a bridge rectifier circuit the maximum voltage across any diode is approximately:

a. Half the transformer secondary voltage
b. One-fourth the transformer secondary voltage
c. Full transformer secondary voltage
d. Twice the transformer secondary voltage

___ 33. The maximum voltage across the diode in a half-wave rectifier is approximately:

a. One-fourth the transformer secondary voltage
b. Half the transformer secondary voltage
c. The transformer secondary voltage

___ 34. In a pi-section filter, if the choke should open, the voltage supplied to the load would:

a. Go to zero
b. Have excessive ripple

c. Increase
d. b and c above

___ 35. In a pi-section filter, if the output capacitor should open, the voltage supplied to the load would:

a. Go to zero
b. Have excessive ripple
c. Decrease
d. b and c above

___ 36. In a pi-section filter, if the input capacitor should short, the voltage supplied to the load would:

a. Go to zero
b. Have excessive ripple
c. Decrease
d. b and c above

___ 37. The input voltage to a full wave rectifier is 120 volts at 60 Hertz. The output frequency is:

a. 30 Hertz
b. 60 Hertz
c. 90 Hertz
d. 120 Hertz

___ 38. A zener diode is used in power supply circuits for which of the following:

a. Rectify voltage
b. Step up voltage
c. Step down voltage
d. Regulate voltage

___ 39. Higher than normal voltage reading across an emitter resistor would most likely be caused by:

a. Open transistor
b. Transistor not conducting
c. Open collector resistor
d. Shorted transistor

___ 40. You are servicing a transistor receiver and suspect trouble in the push-pull output stage. The service diagram indicates Class B bias. You decide to measure the combined emitter currents. What reading do you expect if the stage is normal?

a. Constant current, with or without a signal.
b. The current should increase directly with the signal strength.
c. The current should increase inversely to the signal strength.
d. There is no value in making this check.

___ 41. In a solid state amplifier, you find a shorted decoupling capacitor. The resistor between the capacitor and the +12 volt supply is 330 ohm 1/2 W. You will probably find the resistor?

a. Burnt up
b. Increased in value
c. Decreased in value
d. Undamaged

___ 42. The term "load impedance" as used in connection with the output circuit of a transistor amplifier:

a. Means the total impedance of the complete output circuit
b. Refers to the impedance of the output circuit which is external to the transistor
c. Does not include the input impedance of the next stage
d. There is no specific meaning of this term

___ 43. A transistor which is going into oscillation can be found by shorting the base to the emitter. How does this affect the operation of the transistor?

a. Increases output
b. Transistor stops conducting
c. Decreases output
d. Causes transistor to oscillate

___ 44. An interstage coupling capacitor of a transistor radio is leaky. The capacitor is connected between the collector of the first stage and the base of the second tage. The leakage current would cause?

a. Increased forward bias in second stage
b. Decreased forward bias in second stage
c. Distortion in output stage
d. a and c above

___ 45. In testing a transistor in a circuit shorting base and emitter causes:

a. Increased forward bias
b. Decreased reverse bias
c. Zero forward bias
d. No change

___ 46. Limiters in FM receivers are used to:

a. Limit the amount of frequency deviation
b. Provide a constant amplitude output signal
c. Convert AM to FM
d. Remove amplitude modulation from the AM signal.

___ 47. The rate of frequency swing of an FM transmitter is:

a. Proportional to the amplitude of the modulating signal
b. Proportional to the frequency of the modulating signal
c. Proportional to the oscillator plate voltage
d. Inversely proportional to the modulating index

___ 48. A symptom of misalignment of an FM receiver is:

a. Loss of gain
b. Loss of sensitivity
c. Distortion which changes with tuning
d. All of the above

___ 49. An AFC circuit compensates for tuner drift by:

a. Adjusting the intermediate frequency
b. Adjusting the oscillator frequency
c. Adjusting the signal frequency
d. Adjusting the resonant frequency of the detector

___ 50. The leakage current in a transistor, I_{cb}, is:

a. Present in all transistors
b. Decreases in proportion to junction temperature
c. Causes increase in collector current uncontrolled by base current
d. a and c above

Quinmester Post-Test

Name _____ Date _____ Score ____

Part-Two

Return part-one of this test to the instructor when you have completed your answers. The instructor will issue to you along with this question sheet for part-two a copy of the textbook, Radio Service Training Manual. Use the book to refer to the figures around which the following test questions have been written.

Example: Refer to Figure 10-2, page 167, all questions under this caption will be derived from this particular figure. Now commence with the first question.

Refer to Figure 9-3, page 136

1. What would happen to transistor X6 if C9 shorted?

2. What effect would C9, being shorted, have on the sound output?

3. Explain in detail what would happen to the voltages at X6 if R22 should open?

4. Name three components which if defective could cause R29 to burn.

5. If R27 should open, what effect would this have on the sound?

6. Which voltages would change if C8 were leaky?

Refer to Figure 9-14, page 152

7. In Fig. 9-14, all DC voltages are normal, the antenna section is good, the oscillator is working properly, and there is no variation as the set is tuned across the dial and no sound. If the audio section is working normally, what is the most likely trouble?

8. If R10 opened, how would this affect the current drain on the battery?

9. If R10 opened, how would this affect the collector voltage at X1?

10. How would an open R10 affect the collector voltage at X4?

Refer to Figure 10-2, page 167

11. Name at least three components, which if defective, could increase the forward bias on transistor X4.

12. What would happen to the base voltage of X4 if R9 should increase in resistance?

13. There is an error in the Schematic Figure 10-2, what is it?

14. If a radio were actually wired this way, how would the sound be effected?

15. In paragraph 10-10, page 171, the statement is made that "A transistor which is going into oscillation can be found by shorting the base to the emitter." How does this affect the immediate operation of the transistor?

16. What is the first step in testing a portable transistor radio?

17. What would happen to the sound if R17 in Fig. 10-3, page 170, should open?

18. What is a variator?

19. Explain the purpose of R22 in Fig. 10-1, page 166.

20. While checking the radio represented in Fig. 10-1, page 166, you find that the collector voltages of X5 and X6 are 9 volts; base voltages are zero, and emitter voltages are zero, which part would you suspect first?

Refer to Figure 11-10, page 195

21. What is the purpose of L9?

22. If transformer T1 should develop a short between primary and secondary, which component, other than the transformer itself, would likely go bad first?

23. Which component would go bad first if the secondary of T1 should open?

24. What is a heat sink?

25. Why should a heat sink be used with X1 in Fig. 11-10?

26. What would happen to transistor X1 if C2 shorted?

27. Describe the symptoms which would occur if R30 opened?

28. Describe the symptoms which would occur if C23 opened?

29. Explain how adjusting R3 can determine the collector voltage of X1?

30. Explain thermal runaway in a transistor.

Refer to Figure 13-6, page 251

31. Describe the symptoms which would occur if M5 were open.

32. Describe the symptoms which would occur if M5 shorted?

33. Name five components, any of which if defective, could keep the stereo indicator lamp from lighting and have no affect on the stereo operation of the set.

34. Describe the symptoms which would occur if C50 were leaky.

35. Describe the symptoms which would occur if C52 were shorted.

36. Describe the symptoms which would occur if X1 shorted E to C.

37. What is the purpose of R34?

38. Why is it not necessary to have 67K nz traps in the grid trap of the 19K hz input amplifier?

39. Describe the symptoms which would occur if C58 opened.

40. Describe the symptoms which would occur if C58 shorted.

Answer Key to Quinmester Post-Test

Part-One

1. b
2. c
3. a
4. b
5. b
6. a
7. b
8. b
9. b
10. a
11. d
12. c
13. d
14. b
15. d
16. a
17. a
18. b
19. b
20. d
21. b
22. a
23. c
24. c
25. b
26. d
27. c
28. d
29. c
30. a
31. b
32. a
33. c
34. a
35. d
36. a
37. d
38. d
39. d
40. b
41. b
42. b
43. b
44. d
45. c
46. b
47. b
48. d
49. b
50. d

Part-Two

1. X6 would go to saturation.
2. Sound would be very distorted.
3. When R22 opens E_b goes to 5.7 volts, causing saturation. Instantaneous conduction is by passed by C9. Continued conduction, due to increased forward bias, increases the voltage drop across R24, decreasing forward bias and decreasing conduction which then causes the forward bias to increase and repeat the sequence. (The radio will motorboat.)
4. X7 or X8 shorted. R26 open.
5. No sound.
6. X5 collector, X6 bias, emitter, and collector.
7. An open diode detector.
8. Current would increase.
9. Voltage would decrease.
10. No effect.
11. Shorted C3. Collector to base short in X4. R8 increase in value.
12. The base voltage would decrease.
13. The emitter and collector of X6 are reversed.
14. Lowered volume and possible distortion.
15. The transistor is turned off due to the removal of forward bias.
16. Check the battery.
17. Probably there would be very little effect with the exception of a slight reduction in gain due to increased AVC action.
18. A device which changes resistance with temperature.
19. In the event of increased conduction of X5 or X6, the voltage drop across R22 would increase causing a decrease in forward bias. This would limit current flow and possibly save the transistor from destruction.
20. R20 is open.
21. L9 is a filter choke.

22. R32.

23. R32.

24. A heat sink is a device used to dissipate transistor heat in order to prevent thermal runaway.

25. The transistor must dissipate almost one-half watt of power and would overheat.

26. The transistor would cut off.

27. The base voltage of X1 would go to 11.8 volts and cut the transistor off. This would cause the emitter voltage to go to 11.8 volts, collector voltage to drop to zero, and result in loss of sound.

28. The gain of the output stage would decrease, decreasing volume.

29. Adjusting R3 varies the bias on X1 which varies conduction. The conduction of the transistor determines the voltage drop across the collector load.

30. Thermal runaway is the condition which results when collector current increases due to heat. The increase in current produces more heat which results in increased current. This process can continue until the transistor destroys itself.

31. There would be loss of stereo with no audio from channel two.

32. Loss of stereo due to lack of separation.

33. The lamp, X1, R40, R41, and C53.

34. Loss of stereo; no indication from the indicator lamp, and possible squeals.

35. Complete loss of stereo; no indication from the indicator lamp.

36. The indicator lamp would stay lit whenever the set was on.

37. R34 feeds a positive voltage to the diode and maintains a slight forward bias.

38. This circuit is tuned to 19 Khz by L12 and will reject other frequencies.

39. There is probably no noticeable difference. There would possibly be a slight deterioration in channel two on materials recorded from the stereo.

40. Loss of signal on channel two.